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California Energy Commission

Energy Efficient Natural Gas Use in Buildings Roadmap

Prepared by DNV KEMA

Betty Seto

Jonathan Taffel

Rachel Schiff

Stakeholder Workshop (Residential)

Sacramento, California

Friday, October 18, 2013



Agenda

Focus Area: Residential Buildings

Time	Topic
9:30 AM	Introduction and Overview
9:45 AM	Natural Gas Usage Characteristics
10:00 AM	Overview of Preliminary Research Areas
10:45 AM	Discussion Q&A
12:00 PM	Lunch
1:00 PM	Instructions for Breakout
1:15 PM	Breakout session
2:15 PM	Report-back
3:15 PM	Public Comment
4:30 PM	Closing and Next Steps



Project Overview and Workshop Objectives



Project Description and Goals

- Project started May 2013; Public draft scheduled late 2013/early 2014
- Goals:
 - Inform upcoming Natural Gas Research, Development and Demonstration Program: *Proposed Program Plan and Funding Request for Fiscal Year 2014-2015*
 - Summarize status of current technology and potential for energy savings
 - Identify what areas and technologies require research to overcome barriers

Develop a **research roadmap** for residential and commercial buildings, across all natural gas end uses based on stakeholder driven process



Project Research Completed to Date

- Baseline Investigation: Compiled past, current and new research related to natural gas energy efficiency in buildings
 - Literature review
 - Publicly available reports
- Interviews with Industry Experts
 - 43 completed interviews
 - 35 different organizations (trade, utility, non-profit, government)
 - Across different sectors and end uses



Literature Review Sources

Key Sources for Baseline Investigation of Past and Current Research*

Type	Organizations
California ratepayer funded	California Energy Commission California Public Utilities Commission Emerging Technologies Coordinating Council PG&E Food Service Technology Center Southern California Gas Company
Trade organizations	American Council for Energy Efficient Economy American Gas Association Gas Technology Institute
Federal entities	U.S. Department of Energy (DOE) National Renewable Energy Laboratory Lawrence Berkeley National Laboratory Oak Ridge National Laboratory Pacific Northwest National Laboratory



List of Organizations of Experts Interviewed

Affiliated International Management LLC	Gas Technology Institute
Air-conditioning, Heating & Refrigeration Institute	Harpiris
American Council for Energy Efficient Economy	Heschong Mahone Group/TRC
Balance Point Home Performance	James J. Hirsch & Associates
California Public Utilities Commission	Koeller and Company
Center for Energy and Environment	Lawrence Berkeley National Laboratory
Chitwood Energy Management, Inc.	McHugh Energy Consultants
CNT Energy	National Renewable Energy Laboratory
Colorado State University	Natural Resources Defense Council
Davis Energy Group	Oak Ridge National Laboratory
DTE Energy	Pacific Gas & Electric (PG&E)
E Source	Sempra Energy
Ecova	Taylor Engineering
Energy Solutions Center	The Benningfield Group
Enovative Group, Inc	Trane
Enovative Kontrol Systems	US Energy Information Administration (EIA)
Food Service Technology Center	



Today's Workshop Objectives

- Present research results to-date
- Obtain feedback and input on:
 - Recommendations for priority research needs to maximize natural gas energy efficiency
 - Status of energy efficiency technology development for natural gas energy efficiency
 - Problems and challenges that affect natural gas energy efficiency
 - Data and research gaps that are barriers to maximizing energy efficiency
 - Recommendations on partnership opportunities

Goal: Identify the research needed to achieve reductions in natural gas energy usage in residential and commercial buildings



Background: Natural Gas Usage Characteristics



Residential Buildings

- To prepare for a productive dialogue, need to provide context
- What have been the trends of natural gas consumption?
- Which housing types are the heaviest natural gas consumers?
- Which end-uses are the most intensive?
- What new data should we expect to see in the coming months?

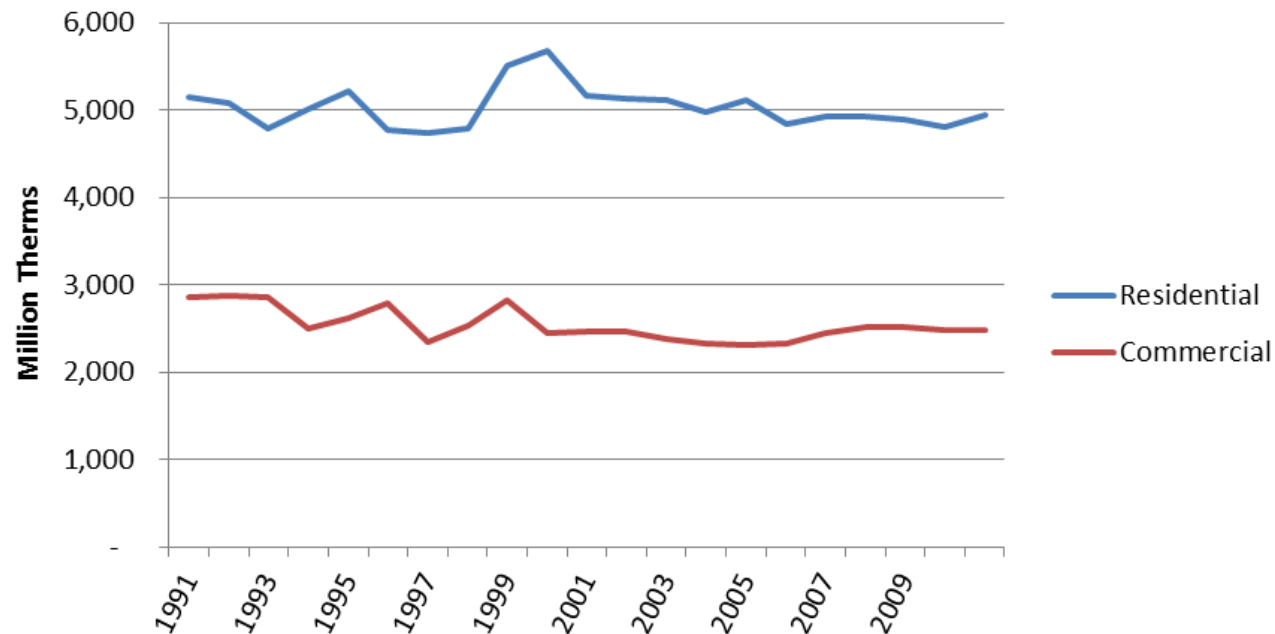


The next few slides will paint the natural gas landscape of California



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Historic Natural Gas Consumption in California Buildings



- Overall, steady natural gas consumption in both residential and commercial sectors
- In 2009, residential sector roughly double consumption of commercial sector

Source: U.S. Energy Information Administration. State Energy Data System (SEDS). June 2012.

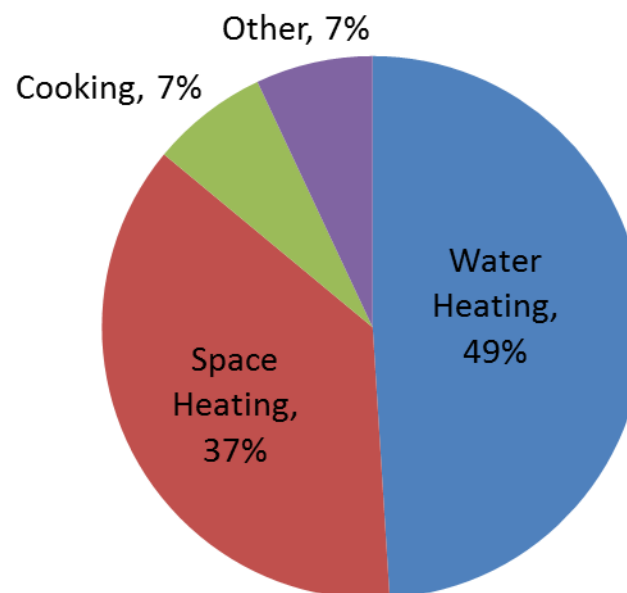


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Estimated Residential Natural Gas Consumption by End Use (2009)

	Billion Therms/Year
Water Heating	2.50
Space Heating	1.89
Cooking	0.36
Other	0.36
TOTAL	5.10

Residential Natural Gas Consumption by End Use (2009)



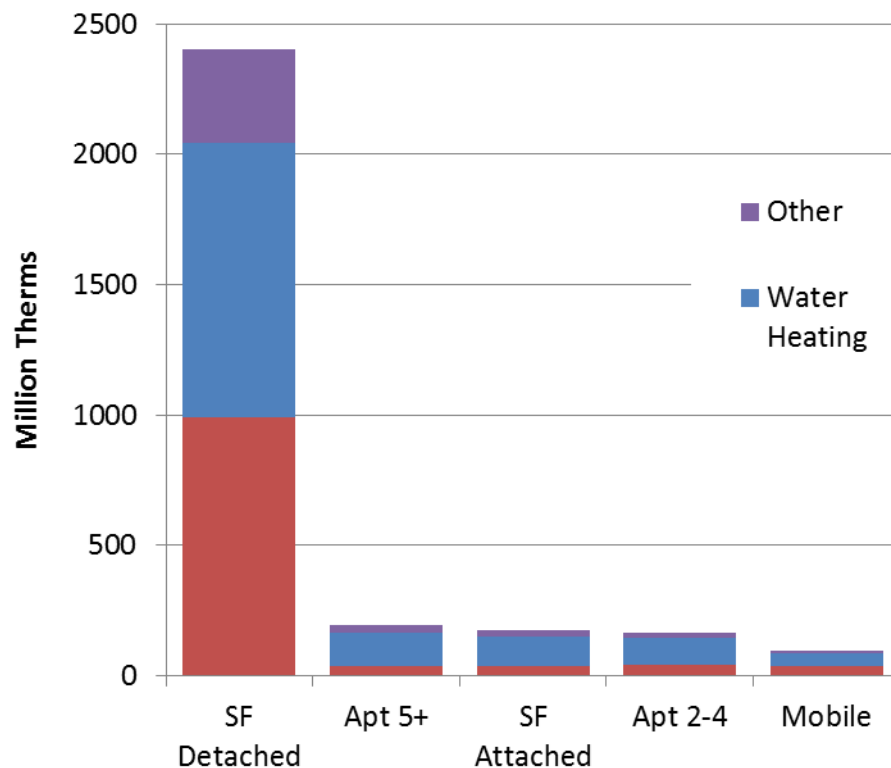
- Water heating the most intensive end use, followed by space heating
- Efficiency means and saturation data are not yet available, but are expected to be released shortly through the CPUC's CLASS

Source: Residential Appliance Saturation Survey (2009)



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Residential Natural Gas Consumption in California¹ by End Use and Building Type (2009)



- Single-family detached units consume 79% of residential natural gas
- Within single-family detached homes, 44% of gas use is from water heating and 41% is from space heating

Vast majority of consumption

Water and space heating within SF
Detached homes

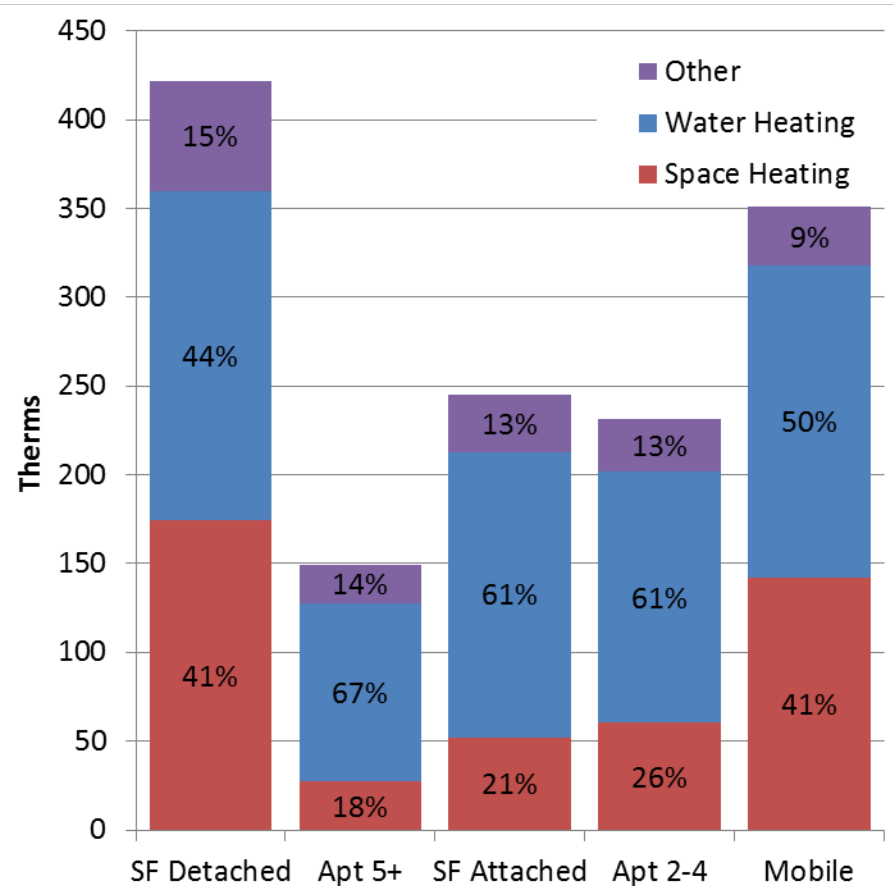
Source: CEC Residential Appliance Saturation Survey (RASS) 2009

¹ Data from RASS consider homes in California that are within IOU territories, that DNV KEMA believes is a representative sample of the state.



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Residential Natural Gas Consumption in California¹ per Residence by End Use and Building Type (2009)



- Water heating is most intensive end use all housing types
- In apartments and SF attached residences, space heating is substantially less intensive than SF detached and mobile homes

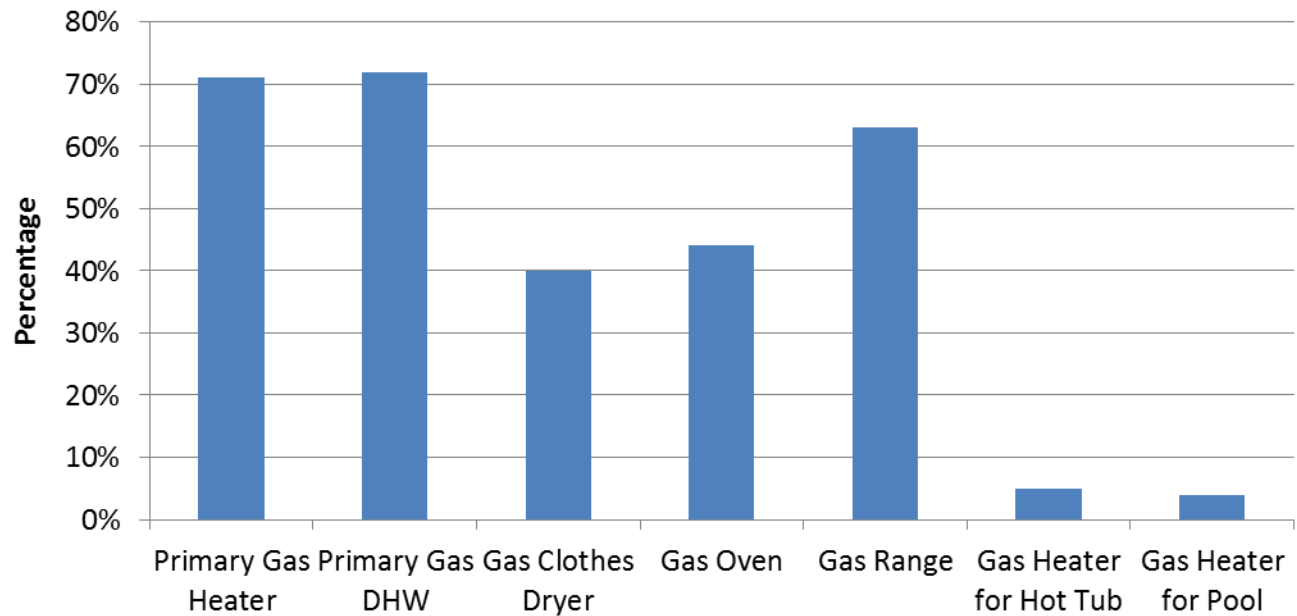
Source: CEC Residential Appliance Saturation Survey (RASS) 2009

¹ Data from RASS consider homes in California that are within IOU territories, that DNV KEMA believes is a representative sample of the state.



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Percentage of California¹ Homes With Various Natural Gas Appliances (2009)



- Natural gas shares are calculated among all California homes
- Primary heater and DHW are fueled by natural gas in 82% and 75% of homes, respectively

Source: CEC Residential Appliance Saturation Survey (RASS) 2009

¹ Data from RASS consider homes in California that are within IOU territories, that DNV KEMA believes is a representative sample of the state.



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Gas Water Heater Type in Homes within California IOU Territories (2009)

Appliance Type	2003	2009
Standard Gas Tank	98%	95%
Whole House Tankless Gas WH	2%	4%
High Efficiency Condensing Gas WH	0%	1%
Solar Water Heater with NG Backup	0%	0%

- Vast majority of gas water heating is standard storage tank
- Increase seen from 2003 to 2009 in tankless, but still relatively small

Gas Space Heater Type in Homes within California IOU Territories (2009)

Appliance Type	2003	2009
Central Forced Air Gas Furnace	70%	74%
Floor or Wall Gas Furnace	28%	22%
Hot Water Gas Radiator	1%	1%
Gas Fireplace	0%	1%
Other Gas Heater	1%	1%

- Large majority of gas space heating is central air
- Increase seen from 2003 to 2009 in central forced air (and reduction in proportion of floor or wall gas furnace)

Source: CEC Residential Appliance Saturation Survey (RASS) 2009



Additional and Upcoming Research

Residential Only (All Incomplete)

- CLASS (CPUC)
- Whole House Retrofit Evaluation (CEC and CPUC)
- HVAC Quality Install Evaluation (CPUC)

Residential and Commercial

- Energy Efficiency Potential Study (CPUC)
- Macro Consumption Pilot Study (CPUC)
- Measure Cost Study (Incomplete) (CPUC)

Commercial

- Commercial Saturation Study (incomplete) (CPUC)
- Commercial Market Share Tracking study (incomplete) (CPUC)
- Custom projects evaluation (interim report available) (CPUC)



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- Single family homes continue to be the dominant residential consumer of natural gas
- Water heating and space heating, as dominant end-uses
- Equipment efficiency data and saturations should be released soon



The majority of residential natural gas consumption is for space and water heating in single-family homes.

What are the opportunities for reductions?



Overview of Initial Priority Research Areas Identified to Date



Initial Priority Research Areas

- Based on interviews with 43 industry experts and literature review of 31 research initiatives
- Organized by End Use
 - Water heating
 - Space heating
 - Other



Water Heating

Key findings: Largest natural gas end use, with well-documented body of research; well-organized industry initiatives

Research Recommendations

1. Develop cost effective high efficiency water heaters leveraging natural gas heat pump technology

- “Triple-integrated appliance” for space heating, cooling and water heating
- Heat pumps can have maximum efficiencies that are similar to condensing technology
- Demonstration projects to overcome technical issues and reduce costs

2. Develop and demonstrate cost effective waste heat recovery, including combined drain heat and greywater capture

- Drain heat recovery from showers applicable to single story homes



Water Heating

Research Recommendations (continued)

3. Develop low-cost solar systems with focus on new materials (e.g., polymers)

- Ultra-low cost solar water heaters with goal selling units for \$1000 or less
- Polymer materials with similar conductive properties to copper and glass

4. Support water distribution system design research

- More attention needed for systems perspective (lagging behind improvements to efficiency of heating equipment)
- Optimal configuration of piping and alternatives to recirculation systems

5. Collect and characterize energy use related to water heating across different building types, designs and vintages.

- By building type, vintage and consumption (fixtures)
- Real-world data on water system design
- Data needed to update uniform plumbing code



Space Heating

Key findings: Proportion of residential natural gas used for space heating has decreased (both state-wide and nationally). Residential gas furnaces approaching 100% efficiency; more attention needed for cost-effective high efficiency

Research Recommendations

1. More research related to quality installation issues for heating systems in residential applications

- HVAC systems may only be at 50% delivery energy performance (e.g., 90% AFUE is operating at 45% efficiency)
- Installation practices and understanding real-world efficiency versus rated efficiency



Space Heating

Research Recommendations (continued)

2. More research related to natural gas heat pump technologies and combined space heating and water heating technologies

- Historically poorly installed; need to aggregate more recent research and data
- Demonstration projects to show lifecycle payback

3. Support research to improve efficiency of ductwork, including duct sealing and moving ducts into conditioned space

- Duct sealing to focus on the most significant leaks and new construction practices
- Duct right-sizing and ducts in conditioned space



Other

Key findings: Remaining recommendations that cover other end uses or whole building

Research Recommendations

1. Support development of more efficient gas dryers

- ENERGY STAR standard underway, including test procedures
- Research exhaust heat recovery to pre-heat air coming into the dryer
- Better insulated dryers and automatic termination

2. Conduct study of economic and technical potential for heat recovery

- Research to identify overall potential for cost effective waste heat recovery from all sources including drain water (e.g., dishwashers, showers).
- Identify areas to focus on and develop a roadmap for synergies between different technological opportunities



Other

Research Recommendations (continued)

3. Develop additional efficiency rating systems for combined space and water heating systems

- Move away from two combustion sources (e.g., water heater and furnace)
- Rating method to help market understand the value of these products
- Build a standard for a product that is not yet regulated.\

4. Additional research for reduced air emissions related to burners while increasing energy efficiency

- NO_x controls for new energy efficient equipment
- Challenges increasing system efficiency while reducing cost and NO_x



Discussion and Q&A



Lunch

Meet back here afterwards.



Instructions for Breakout Sessions



Breakout Sessions: Sacramento, CA

Topic	Location	Facilitator
Water heating	Hearing Room B	Rachel Schiff
Space heating/cooling	Fishbowl (2 nd Floor)	Jon Taffel
Other	Fishbowl (3 rd Floor)	Betty Seto

1. Review initial priority research areas
 - a) What is the status of technology development?
 - b) What are specific tasks and next steps? (3-5 actions)
 - c) What are partnership opportunities?
2. Identify what research areas may be missing as priorities
 - a) What problems or challenges need to be overcome?

Designate someone to report back to the group. Meet back here at 3:15 PM



Breakout Session Report Back



Final Public Comments



Next Steps: Prepare a Roadmap

- Prepare draft roadmap
- Research initiative descriptions that include:
 - An initiative description, including areas of potential applied research/demonstration
 - Clear issue statement
 - Status of past research
 - Policy context and justification
 - Estimated baseline natural gas use to be affected
 - Estimated natural gas savings and co-benefits
 - List of research beneficiaries by location
 - Tasks required for realizing full potential
 - Barriers to full potential and how research helps



Contacts

Please send any additional written comments by Monday 10/21 COB

Jeffrey.Doll@energy.ca.gov

California Energy Commission

Betty.Seto@dnvkema.com

DNV KEMA Energy & Sustainability

Office: 510-891-0446